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Two-part onboarding for game-based learning environments

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The trend of introducing game-based elements and mechanisms via game-based learning (GBL) and gamification is expanding in higher education, as is research on the elements of gamification design that contribute to their effects on learning. This paper presents a two-part onboarding process as a game-design element, analyzing its underlying mechanisms and potential effects on student learning through theoretical frameworks. First, we introduce a two-part onboarding intervention designed as part of introducing GBL in higher education. The intervention aims to address a challenge students face when taking a GBL module or course: namely, that venturing into a new digital platform often brings with it new and unfamiliar expectations of how students should act and interact in order to effectively engage with the course material as well as with their peers and instructors. Second, we describe two projects through which the intervention evolved to its current form. Third, we analyze and apply two theoretical frameworks—on semiotic domains and cognitive load—to examine the underlying mechanisms by which the intervention may be expected to affect student learning.

KEYWORDS

game-based learning, higher education, online learning, cognitive domains, escape rooms, learning environment

1. Introduction

Increasing amounts of research on game-based learning (GBL) environments, from pre-school to university level, demonstrate wide-ranging effects of GBL on students' academic achievement (Connolly et al., 2012; Wouters et al., 2013; Clark et al., 2016; Karakoç et al., 2020; Sailer and Homner, 2020). Games can improve students' critical thinking (Mao et al., 2021), spur intrinsic motivation that positively affects student performance (Hess and Gunter, 2013), improve engagement (Looyestyn et al., 2017), and act as effective assessment engines (Shaffer and Gee, 2012). Overall, introducing game-design elements has been shown to improve student learning compared to more traditional learning methods, both in physical and online environments (Briffa et al., 2020; Sailer and Homner, 2020).

However, not all connections between gaming and learning are causal or positive. For one, particular elements of gamification affect particular aspects of learning and in different ways (Sailer et al., 2017). Also, there are elements that are crucial to gaming, which have little to no moderating effect on gamification in learning; for example, even though gaming experience relies on collaborative skills and peer competition, neither has a moderating effect

on learning through games (Ho et al., 2021). Mixed results also come from studies on one of the most often cited reasons for gamifying learning environments: motivation. Some studies show that gamification enhances motivation in educational context (Sailer and Homner, 2020; Oliveira Jordao do Amaral and Kang, 2021; Mula-Falcón et al., 2022), while others have found no increase in student motivation after implementing gamification (Domínguez et al., 2013; Hanus and Fox, 2015; Faust, 2021; Tanirbergenovna et al., 2021). Variability of the effects that elements of gamification have—or not have—on student learning reinforces the need to keep exploring different ways to design and implement game-design elements in learning environments in ways that will facilitate student learning.

1.1. Onboarding to new learning platforms

Integrating GBL in higher education, while demonstrating benefits, carries with it challenges of its own. Two aspects of learning most often associated with GBL and gamified learning are engagement and motivation (Zainuddin et al., 2020). In addition to motivation and engagement as two aspects of learning that receive most benefit by gamification, social interactions belong to that list (Kalogiannakis et al., 2021). Plass and colleagues argue that integrating social aspects into game design needs to be intentional and purposeful in order to contextualize and facilitate learning (Plass et al., 2015). This follows a broader trend of inviting instructors and GBL designers to more consistently incorporate multiple theories of learning as well as gamification frameworks into GBL design and to combine gamification principles with those of educational development and design (Baldeón et al., 2016). However well-intentioned and important this invitation is for creating effective learning environments, it runs against a counter-current of instructors already facing a series of challenges and obstacles, such as costs, logistical support, experience with and attitudes toward technology, and resources and ability to carefully apply gamification place further obstacles (Zourmpakis et al., 2022), as well as the expectations to keep up with the rapid development of technologies (Kalogiannakis and Papadakis, 2019). This opens the space for simpler interventions that positively affect students' learning trajectory.

When students enter a new learning environment, especially environments purposefully designed to maximize learning opportunities—their ability to avail themselves of those design features is dependent on the instruction and support provided by teachers. When no teachers are present, students are left with their own perception of the rules of engagement and the affordances of the space (Young and Cleveland, 2022). As GBL spaces typically do not involve teachers, students learn about the rules of navigating the space in ways similar to how players learn the rules in a video game. Video games often do not require onboarding. Instead, they have playing levels designed in ways to help players master skills they need as they proceed through the game (Pasqualotto et al., 2023). Onboarding in video games is merely the first level. Players receive support and feedback (scaffolding), which is then gradually withdrawn as players gain skills necessary to proceed with the game and move on to higher levels (Plass et al., 2015). The thorough integration of learning new rules in gaming environments demonstrates their importance for shaping engagement for learners (Gee, 2007).

Tekinbas and Zimmerman list two types of rules necessary for players to master in order to successfully play a game. The first type is operational rules: these are the logistical rules of the game, i.e., knowing what the possibilities and limitations are within the scope of the game, as well as what actions and moves lead to what kinds of benefits or consequences. The second type is implicit/behavior rules: these are the rules equivalent to fair play, i.e., the rules that facilitate social behaviors and interactions among players (Tekinbas and Zimmerman, 2003). Non-instructional games that take place on digital platforms (i.e., video games for entertainment) typically do not expect the players to have mastered these rules prior to playing the game. Instead they learn the rules through practice, such as through training in sports, or by moving from lower to higher levels in video games. But GBL environments include the additional layer of learning goals in addition to mastering the rules of the game, thus raising the question whether onboarding as a game-design element is needed more in GBL than in non-instructional games.

Onboarding has received relatively little attention, both in research and in practice of GBL. An imbalance has been noted in research between game elements that are more frequently addressed (such as points, badges, leaderboards, and competition), and those that receive less attention (such as avatars, storytelling, and quizzes) (Kalogiannakis et al., 2021). Onboarding decidedly falls into the latter category. Comparing to other gaming elements, onboarding in terms of instructions and support that students receive prior to commencing a game has received relatively little attention in research (Erhel and Jamet, 2013; Mora et al., 2017). Consequently, it rarely shows up in literature that looks at different elements to GBL design (Abdul Jabbar and Felicia, 2015). Onboarding is not consistently addressed in practical guides to gamification either, and is variably listed as part of a four-stage player's journey comprising discovery, onboarding, scaffolding, and endgame (Chou, 2013); as part of a three-stage player journey, preceding the stages of scaffolding and progress (Kumar and Herger, 2013); as well as part of a larger Periodic Table of Gamification Elements (Marczewski, 2017). Gamification frameworks, such as the MDA (mechanics, dynamics, and aesthetics) list it as an integral part of gamification design (Ruhi, 2016). It is sometimes referred to as integration (Tomé Klock et al., 2015), or instructions (Erhel and Jamet, 2016). However, despite the relative scarcity of the discussion on onboarding, the need that onboarding aims to address—namely, students' unfamiliarity with GBL and gamification and the consequent need to bridge that gap in order to facilitate student learning—is acknowledged (Ding et al., 2018).

In this paper we address a two-part onboarding approach that is both simple to implement and covers two aspects of familiarizing learners with a new environment: logistical and social. The onboarding process is placed as a precursor to the learning process and includes two parts. One is a formal tutorial, which covers the logistical aspects of navigating the GBL platform—in other words the set rules of engagement. The other part is a launch event which allows students to build their own collective rules of interaction and social engagement prior to commencing learning activities. In the first part of the paper (section 2) we describe two projects through which the proposed strategy evolved. Both projects were implemented by the education-innovation team of ErasmusX at the Erasmus University Rotterdam, a public research university in the Netherlands, using existing online platforms to create gamified learning environments for students. One project uses a gaming platform, and the other an online platform that

was gamified for the purposes of the project. In the second part of the paper (section 3) we examine the theoretical background and create a conceptual framework to help explain the effects that onboarding process may have on students who learn in digital GBL environments that are new to them. Since many articles on GBL and gamification do not provide a theoretical basis (Kalogiannakis et al., 2021) and, when they do, they most commonly use frameworks from the self-determination theory and the flow theory (Zainuddin et al., 2020), in this paper we analyze the game-design element of onboarding through the lens of cognitive load theory coupled with the theoretical framework on semantic domains.

1.2. GBL and gamification

There is considerable overlap between GBL and gamification in the context of learning. They share design process (albeit with different design outcomes) as well as game-based element toolkits (Sailer and Homner, 2020). GBL refers to the use of full-fledged games—physical or virtual—for instructional purposes and with learning goals, typically to increase motivation and engagement of learners (Prensky, 2001). Gamification, on the other hand, is the application of game-design elements and principles in non-gaming contexts, including learning environments (Deterding et al., 2011). However, gamification originally referred to the application of "game-like accelerated user interface design" increase the speed and engagement with electronic devices (Pelling, 2011). To date, the term is still occasionally used without specifying whether the resulting environment is a full-fledged game or not, defining it, for example, as "using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems" (Kapp, 2012, p.10). Both GBL and gamification share the principle of using game elements and mechanics for the purposes that are not limited to entertainment, such as solving tasks and promoting learning, as well as the effects they have on learners (Hou, 2023). Consequently, GBL and serious games share with gamification many of the design and theoretical principles (Landers, 2014; Krath et al., 2021). In this paper, we use the term gamification not in its narrow sense where it is applicable only to non-gaming contexts, but in its broader sense of applying gaming elements to the learning process. We refer to gamification as including both gaming elements (mechanics, aesthetics, and thinking) and process (applying game-based elements in various activities, including learning). The two projects we describe below are both examples of GBL, but the strategy of building interactive onboarding that we expound on in this paper may apply to learning environments that comprise gaming elements whether they are bona-fide games (GBL) or not (gamification) as long as they require learners to enter new platforms or environments. Consequently, the implications of introducing the strategy of interactive onboarding may extend beyond GBL to gamification as well.

2. GBL project examples: introducing students to GBL environments

At the Erasmus University Rotterdam, the ErasmusX team works on innovation in higher education using human-centered approaches and emerging technologies and focusing on student engagement and autonomy (Zafar and Paas, 2022). Two ErasmusX projects described below were initiated with the goal of enhancing students' engagement and sense of belonging as a way to improve their learning process and their overall experience at the university. Both projects used existing virtual online platforms: Minecraft and Gather, respectively. Using the environment and logic of Minecraft in education draws on the potential for educational value that lies in combining playing games with making games, i.e., in combining the constructivist with constructionist approach (Garrelts, 2014; Kafai and Burke, 2015). Gather, on the other hand, combines a virtual online environment with proximity-based video conferencing (McClure and Williams, 2021), with the goal of mimicking the interactivity of a physical space; it thus provides a more embodied online learning experience. While Minecraft is a gaming platform, Gather is not; however, the design team gamified it by shaping it into a learning environment that comprises gaming elements for the purpose of facilitating learning.

2.1. Project 1: Minecraft Virtual Campus

The Minecraft Virtual Campus project arose from the changes induced by the onset of the COVID-19 pandemic in 2020. Responding to feedback collected from students about feeling isolated and lacking connections, the ErasmusX team used the online gaming platform, Minecraft, to create a digital version of the physical university campus (Figure 1) in collaboration with Erasmus eSports, the university's eSports student association, and Shapescape, a company specializing in Minecraft builds. In doing so, the design team followed models implemented by schools around the world building renditions of their campuses and holding graduation ceremonies virtually (Minecraft, 2020). Even after in-person instruction resumed on campus in 2021, the platform continued to welcome new students to the campus for: (a) onboarding activities, including an interactive scavenger hunt, (b) educational innovation, such as courses that use the platform as part of instruction, (c) marketing and recruitment, and (d) events and celebrations (Zafar and Paas, 2022). For all activities, ErasmusX provided participants who did not own a copy of Minecraft Java Edition with accounts that allowed them to participate.

Below we describe four major activities that the virtual campus has been used for. Before commencing each activity, students first enter the 3D virtual campus that the team created, which closely mirrors the features of four locations of the physical campus, including information boards with information about different buildings. In some cases, students were also invited to contribute to expanding—or, as part of wellness initiatives, destroying parts of—the virtual campus.

2.1.1. Virtual campus tours

During the COVID-19 pandemic, Erasmus University Rotterdam hosted two bachelor open days fully online. As part of the open day, ErasmusX teamed up with the marketing and communication team to host tours in Minecraft for prospective students. The tours took place in the Minecraft campus Woudestein. Groups of 10–15 prospective students would be guided by a student ambassador. As student ambassadors guided prospective students on the Minecraft platform, the Zoom platform was used for voice and video communication among group members. After the tour ended, prospective students were free to explore the campus at their own leisure. To facilitate the exploration, signs with information about

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FIGURE 1
Bird's-eye view of the virtual campus in Minecraft.

FIGURE 2
Participants in the scavenger hunt locate a treasure chest.

buildings were placed around the campus. The tour was designed to allow students to familiarize themselves with the campus and its various features. Feedback collected following these events indicated that participants particularly enjoyed the time to explore the virtual campus on their own.

2.1.2. Scavenger hunt

A scavenger hunt was built in collaboration with Shapescape to onboard new students starting their education at the university during the COVID-19 pandemic. Participants were split into small groups and were issued a set of over forty clues describing specific points of interest across all four campus locations. Teams would then race each other to place each of the clues into the corresponding treasure chests at the various locations. A clue would describe the location of a specific treasure chest, and it was up to participants to locate the chest, travel to that location, and place the clue in the treasure chest. Teams would score one point for each correctly located treasure chest (Figure 2). A real-time score board kept the teams competing with each other throughout the game. A typical game would last 45 minutes. It was designed to help students get to know each other via teamwork in small teams and competition with other teams. The activity also helped students learn about various points of interest on campus.

2.1.3. Pedagogical sciences assignment

Students in the course in pedagogical sciences were originally asked to go to the physical campus and take pictures of places that they associated with various terms related to sense of belonging. They would then expound on why they felt these physical spaces were associated with the specific cue terms. Once the physical campus closed due to the onset of the COVID-19 pandemic, this assignment was no longer doable in person. To help preserve the assignment for over two hundred undergraduate students, ErasmusX teamed up with the course instructor to host the assignment digitally in the Minecraft campus. Students were split into groups of four-to-five students and

asked to do the same exercise: take screenshots of areas on campus that they would associate with specific terms of belonging, e.g., "welcoming". The Minecraft screenshots were underpinned by a few paragraphs of text explaining the reasoning behind the choice.

2.1.4. Destroy the virtual campus during wellbeing weeks

To help students release stress, during the wellbeing weeks organized by the university, ErasmusX ran an event that gave students the opportunity to destroy the Minecraft campus. Students signed into the Minecraft campus and broke through walls one block at a time. Or they threw some well-placed TNT bombs or lava jars. The event was hosted simultaneously in Zoom for audio and video communication and in Minecraft for the actual gameplay.

2.1.5. Takeaways from the Minecraft Virtual Campus project: strengths and challenges

The first sample project, Minecraft Virtual Campus, developed in response to the shutting down of the physical campus at the onset of the COVID-19 pandemic. Informal surveys conducted with students at the time indicated feelings of disconnectedness, isolation, and despondence. The project thus developed and piloted a solution that aimed to infuse users with motivation, engagement, and help them feel part of the university community. Informal surveys conducted with students taking part in different activities described above showed that the project succeeded on all three counts. The project was developed swiftly and in direct response to the emerging student needs. In managing the project, ErasmusX placed strong emphasis on maintaining flexibility in developing unorthodox solutions to meet the needs of the students.

The feedback collected through exit surveys, while positive, was mostly about engagement—specifically students' perception of engagement—and less about performance or learning. Survey results indicated two discrepancies between activities with no explicit learning goals (such as the scavenger hunt) and the one with learning goals (pedagogical sciences). The first discrepancy was that student self-perception of engagement was higher in activities with no explicit learning goals than those with learning goals. The second discrepancy was that, while for more than 80% of surveyed participants overall it was not the first time to play Minecraft, that percentage dropped significantly for the participants in the pedagogical sciences assignment. Considering the correlation between higher levels of engagement and the prior familiarity with the virtual platform, the question arose *whether familiarizing with the virtual platform those participants who are not already familiar with it might positively affect their levels of engagement*. If future activities in Minecraft are to be compulsory (e.g., part of a formal course) rather than voluntary (an elective activity during campus orientation), a design challenge would be to provide a more structured introduction to the platform and its affordances to sustain high engagement levels not only for projects focusing on social interaction, but also when explicit learning goals are part of the experience. This challenge was tackled in the second project.

2.2. Project 2: Gather Escape Rooms

In the second project, Gather Escape Rooms, the ErasmusX design team created an online module of gamified virtual learning spaces in the form of escape rooms, as part of an existing year-long first-year undergraduate course in the Erasmus School of Law. More than 1,500 students enroll in the course every year. Course instructors requested that the new module provide a hands-on introduction to legal online databases with ample opportunity for practice and no performance-based grading. The solution came in the form of three GBL modules where students moved through a series of escape rooms in order to accomplish learning goals without being graded on them. The module was embedded in the Canvas course, and from the students' perspective it comprised three steps: (1) they received logistical information about the module in Canvas, (2) they moved to Gather, where they encountered academic content through texts and videos, and (3) they entered a series of escape rooms that progressed in levels of difficulty and combined logical puzzles with learning content (Figure 3). Working in groups or individually (they were given a choice) students had to look for clues, identify the questions, and find further clues to solve the puzzles, thus moving to the next escape room and toward the end of the module, which they had to complete in a single attempt (and with their group, if they had opted to be part of one). The goals of the module, in addition to introducing students to the course content, included: (a) allowing students to gain practice in an environment where they can make mistakes and learn from them, (b) making the content of the module engaging for students, and (c) creating opportunities for students to engage socially with each other. The module was assessed on completion—students received full credit by completing the module.

For many of the first-year students in their second month of university studies (which is when the online module began), the virtual space of Gather constituted a new type of a learning space. Since new environments often bring with them new affordances and thus new rules of engagement, the design team anticipated that students would benefit from first familiarizing themselves with the new learning space before commencing the module. The standard Gather onboarding tutorial was already available and promised to give students a typical, structured mode of learning the logistics of navigating the platform. However, the design team deemed that it would be beneficial for students to complement this onboarding tutorial with another activity, which would give students the opportunity to socialize with all the members of the course (students and teachers alike) and to do so in a sociable environment. That way, once the module activities commenced, students would be better prepared to not only move through the stages of the module, but do so while communicating and coordinating actions with each other. Consequently, the Gather onboarding tutorial was complemented with a launch event, thus morphing into a two-part onboarding process for students.

Two rationales lay behind the two-part structure of the introduction; both rationales arose from the takeaways gained from the first project, the Minecraft Virtual Campus. The first rationale derived from the inverse correlation between the existence of explicit learning activities and levels of engagement: in the Minecraft Virtual Campus, participants in activities with learning objectives reported lower levels of engagement. Now that there were learning objectives involved, the design team decided to help students familiarize themselves with the platform first. That way, once they commenced with the module, they could focus on fulfilling the learning goals rather than grappling with the mechanics of the platform that was new and thus unfamiliar to most of the students. The second rationale

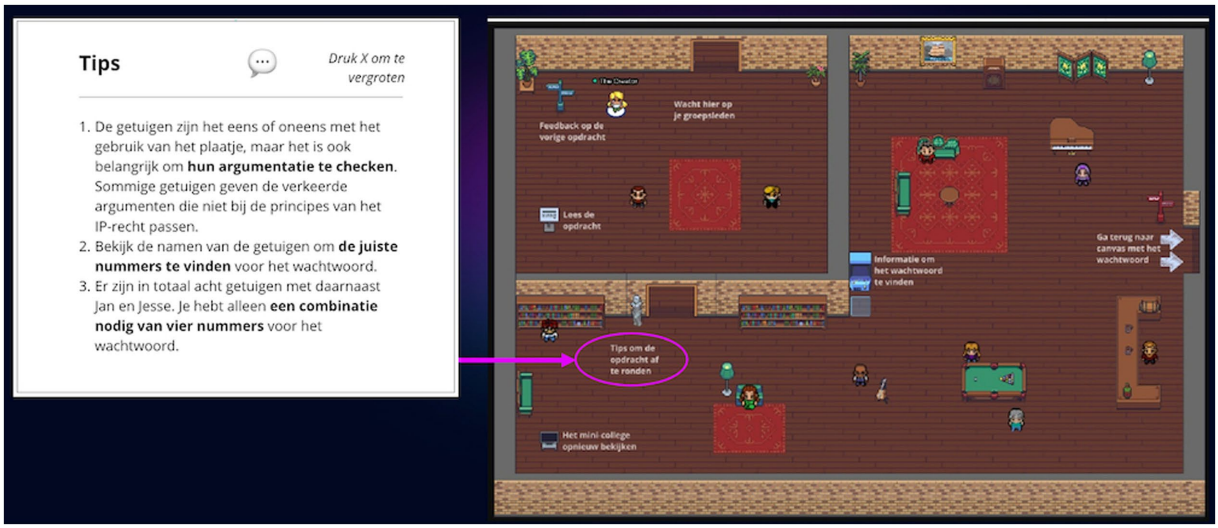

FIGURE 3
Example of an escape room in the GBL module where students look for clues that lead them to a password that will allow them to "escape" the room and move to the next stage of the module. The text on the left appears when law students interact with the library book shelf in the room; it reads: "Tips (click X to enlarge): 1. Witnesses agree or disagree with the use of the image, but it is also important **to check their reasoning**. Some witnesses provide inaccurate arguments that are not in line with the principles of the IP [intellectual property] law. 2. Look for the names of the witnesses **to find the correct digits** for the password. 3. There are eight witnesses in total in addition to Jan and Jesse. You only need **a combination of four digits** for the password."

derived from students' feedback that the opportunity to explore various aspects of the environment contributed to their sense of belonging. To welcome students and provide them a sense of community, the design team decided to first provide them with time and opportunity to explore the environment and familiarize themselves with its various aspects, including interactions with instructors and other students. Both rationales are consistent with research showing that students, when integrating in a new setting, prefer social and collaborative activities to structured courses (Zhang et al., 2017). They are also consistent with the claim by Plass and colleagues that social and cultural interactions center around interactions with objects. They claim that game designers can use objects that require engagement by multiple players as game elements that promote social interaction among players. Game designers already incorporate social expectations and corresponding actions into game design, and they do so sometimes intentionally but often intuitively (Plass et al., 2015). That was indeed the case here with designing Gather Escape Rooms.

Consequently, prior to commencing their work on the module, all students were invited to the launch event. Students met the instructors and support staff, and engaged with each other through organized activities and educational games and challenges, which were interspersed throughout the platform (Figure 4). This was an event akin to a reception organized to welcome students and to orientate them in their new learning environment and to signal through the structure of the space and the event the expectations for functioning within the space and for making the most of it. The welcome event drew a large portion of students enrolled in the class. They explored multiple virtual spaces, engaged with games and puzzles that were set up in the areas, and attended a welcome "reception" hosted by the lead instructor and the vice dean as part of the event. Halfway through the event, a technical glitch appeared: the number of participants in the virtual space reserved for the speakers exceeded capacity, disabling the audio for speakers, and making it impossible to communicate other than through the chat function. The glitch was soon resolved, and eventually served as a welcome reminder that the virtual space and what takes place in it is not error-free (Figure 5). It also demonstrated that the problem-solving that the space was designed for sometimes involves challenges that were not built into the escape-room puzzles, but that can be solved through ingenuity and collaboration, which are skills that the module encouraged students to develop and deploy.

2.2.1. Takeaways from the Gather Escape Rooms project: need for a theoretical framework

The two projects described above describe the evolution of onboarding as a game-design element in a GBL module, from a routine tutorial to a two-part structure that also includes a launch event. The goals of the first project, Minecraft Virtual Campus, were to provide opportunities for students to build social connections, engage with the university campus as a new environment in which they would be spending much of their time over the next few years, and to help students build a sense of belonging. But while the project was created for a higher-education environment, it had few, if any, explicit learning goals that students were expected to achieve (with the exception of the pedagogical sciences assignment described in 2.1.3). On the other hand, Gather Escape Rooms were built as part of a module with clearly defined learning objectives, and the module itself was part of a formal course. The virtual environment was no longer only a place to socialize and familiarize oneself with a new environment, but also a learning space. While social connections, engagement, and sense of belonging continued to be main goals of the project, they were no longer aims in themselves, but were now in service of learning goals. Rather than assuming that those goals would

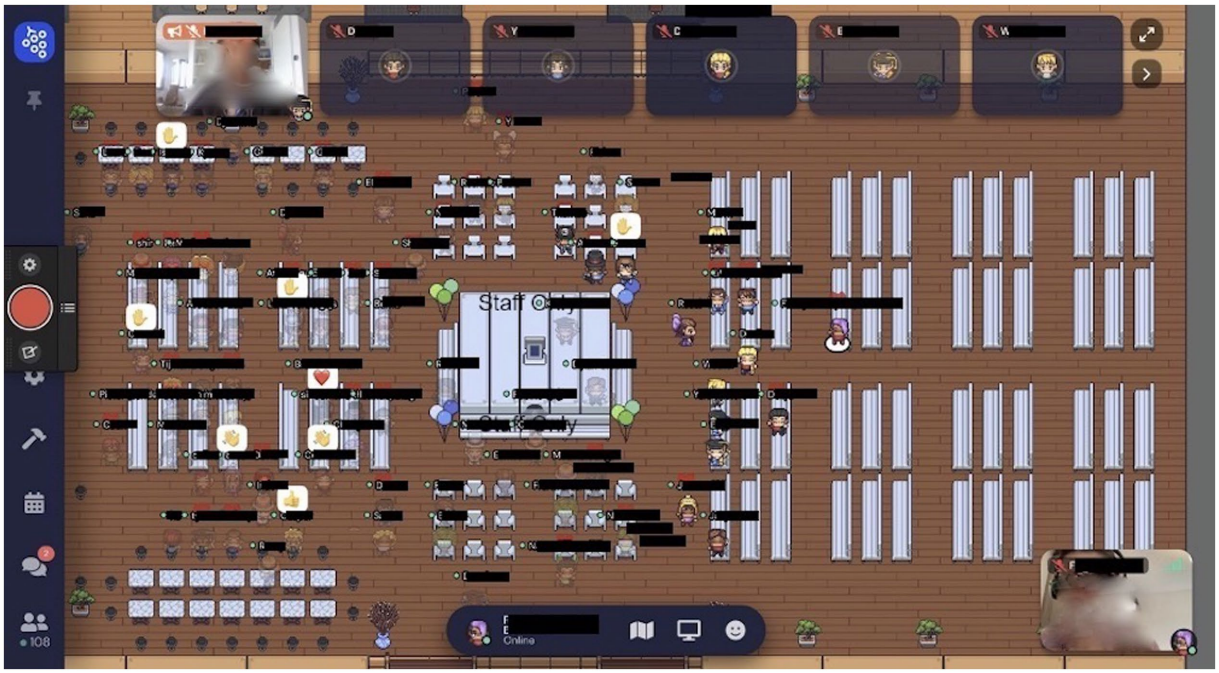

FIGURE 4
Students and the speakers during the launch event.

FIGURE 5
Students and the speakers during the launch event when the technical glitch occurred because too many avatars entered the space in the middle reserved for the speakers. For several minutes communication was limited to the chat functions, but the issue was resolved shortly afterward.

be accomplished spontaneously by students in the course of completing the module, the design team conceptualized and implemented a launch event as a potentially helpful component for students to begin working toward those goals prior to commencing the module.

To examine the potential of the two-part onboarding, in this paper we take a step back to examine the theoretical background for its potential effectiveness. In the first half of the next section, we identify semiotic domains as a theoretical framework that provides a rationale for setting up a framing (in the form of onboarding) for the learning experience in a GBL environment. In the second half of the next section, we deploy cognitive load theory to break down the learning process into extraneous and intrincis factors, and advocate for distributing them sequentially—first extraneous, then intrinsic—to facilitate the learning process. The two theoretical frameworks elucidate the mechanisms of the onboarding, thus providing indications as to how to implement in practice onboarding as a game-design element in GBL environments.

3. Theoretical framework for onboarding to new virtual platforms

Teaching and learning are not merely two ends of a process of transferring content knowledge from teacher to student in a linear fashion and on a purely cognitive level (Wilson, 1993; Wulff, 2005; Ambrose et al., 2010; Freire, 2018). Rather, learning is an embodied experience contextualized by the physical and social environment (Brown et al., 1989; Schumacher et al., 2013). Learners both impact their learning environment, and are in turn impacted by it (Deci et al., 1996; Zimmerman, 2000; Corno and Mandinach, 2004; Reeve, 2012; Stefanou et al., 2013). In addition to the elements of actual interaction between the two, learners' perception of the learning environment too is a considerable factor in determining how the social context influences learning (Lizzio et al., 2002). Learning environments are thus not merely backgrounds in which students go through steps assigned to their learning process, but rather ecosystems the engagement with which affects student learning experience.

Two major premises of this paper are that: (a) if physical and social contexts affect learning, then different learning environments might require different logistical and social skills to facilitate learning and (b) introduction to (new) learning environments can be set up in ways that facilitate acquisition, adaptation, and application of (new) skills necessary to succeed in those particular learning environments.

3.1. New rules in a new environment: semiotic domains and their design grammars

One model of socially contextualized learning that helps analyze the transition from one learning environment to another is that of semiotic domains. Semiotic domains are "area[s] or set[s] of activities where people think, act, and value in certain ways." They can range from scientific fields such as cellular biology, to modernist painting and wine connoisseurship. Members of semiotic domains use certain "set practices" as collectively defined and reinforced within a domain to "communicate distinctive types of meaning" (Gee, 2007). University courses as one example of semiotic domains constitute loci of meaning-making in which social interactions and relations shape the process of learning within a defined physical or virtual space.

Moving from one semiotic domain to another means being able to shift from one set of rules and behaviors to a different one. The challenge in a university environment, however, is that it is not always clear for students when they are stepping into a new semiotic domain. For example, rules of a traditional science classroom may have little to do with the rules of scientific practice, thus equipping students with knowledge and skills that do not automatically transfer into the context of scientific practice (Gee, 2007). Lab-running scientists confirm that students joining labs—i.e. bona-fide science-doing and science-making venues—have to unlearn a lot of what they learned in science classrooms (Holmes and Wieman, 2018). A physics classroom (a place where physics is learned) is thus seen as a semiotic domain separate from a physics lab (a place where physics is practiced). In Gee's terms, the two domains also have different *design grammars*: principles and patterns that are typical of a particular semiotic domain and which the members affiliated with that domain practice and are expected to know and have internalized (Gee, 2007). A physics classroom is often focused on fact retention, skills for successfully passing exams, decoding the unspoken expectations of the teacher, and meeting other requirements of the class. This is a set of rules common for most lecture courses, so a student can move across disciplines with only one design grammar under their belt. On the other hand, the design grammar of a physics lab comprises curiosity, inquiry, scientific method, trial and error, and application. Consequently, a student moving from a physics classroom to a physics lab would need to master a new design grammar even as they technically remain in the same scientific field.

The use of terminology confuses the expectations that are being communicated to students. While moving from a physics class to a physics lab implies a different set of rules (class vs. lab), moving from an in-person class to an online class—or from a lecture-based class to a flipped, active-learning class—does not (both are "classes"). On the contrary, it may imply that there is more overlap in rules in these different types of classes that students are expected to follow than there might be in reality (beyond the basic expectations that students will follow the rules set by the instructor, acquire knowledge, build skills, and receive a grade). In a traditional, lecture-style classroom, the teacher is the rule-setting, knowledge-giving authority, and the students are there to do little else but follow and listen ("attend" in various meanings of the word). If students move from this traditional classroom to one with novel teaching methods (for example, a gamified course), students effectively enter a new semiotic domain with its own design grammar. And yet, both traditional and gamified courses are "courses", and both groups of students are in a "class". This terminology implicitly communicates that the rules and expectations of a lecture classroom apply in the gamified space too, and that it is merely the tools that are different, such as textbook vs. online modules. Conflating physical classrooms with gamified learning platforms by applying the same term, "course" to both, signals to students that they can—and even should—retain to the extent possible the learning habits and behaviors they have internalized previously. But physical, lecture-based classrooms and gamified online courses are disparate semiotic domains with their distinct design grammars, thus requiring different modalities of engagement and learning. Students moving from the former to the latter thus have a new design grammar they

need to learn and internalize in order to effectively navigate the space, interact with other participants, and capitalize on the learning potential of GBL environments.

3.2. First master the rules of the environment: cognitive load theory

In a new learning environment, there are different ways learners go about mastering its design grammar. Students learn primarily by picking up on cues from other, more experienced learners, be it individuals in teaching roles or more experienced peers. But students also pick up on cues from the way the learning environment is structured (Brooks, 2012; Van Horne et al., 2012). A lecture hall signals to students to sit down, keep quiet, passively listen, and ideally take notes. A lab with workstations filled with equipment signals to students to prepare to apply in practice what they have learned from textbooks. Changing the physical structure of the classroom can affect students' learning performance as well as how they interact (Brooks, 2011, 2012). As students move through formal education, they learn to associate particular kinds and elements of learning environments with particular kinds of learning and behavior.

For students to capitalize on the particularities of a gamified online space and not slide back into the habit of following the rules of the physical classroom, it may be beneficial to undertake a conscious transition to a gamified online learning environment at an early stage. We posit that, when students enter GBL online learning spaces, giving them the opportunity to engage with the online space that constitutes their new learning environment prior to starting learning tasks will later facilitate their learning. A carefully framed onboarding for a gamified course can thus help achieve the goals of gamified learning more effectively. It can clearly and unequivocally communicate that a transition is taking place from a traditional classroom to one where the rules of lecture halls or even online courses no longer apply wholesale. It can also communicate—or at least hint and help students intuit—what other rules take their place and what new ways of action, engagement, and interaction will facilitate students' progression through the online module. Alternatively—or complementary—it can prompt students to shape and test on site some of those rules themselves, such as ways of interacting effectively with each other.

An introduction to the learning environment can be implemented by way of an introductory explanation (tutorial) coupled with a brief practicum that frames participants' actions in a gamified online course (launch event). Framing the second part as an event rather than a task compounds it with social interactions that participants can experience and test in a new environment. All of this gives students an opportunity to see, feel, and experience the platform as an environment that centers around their learning experience while recognizing that learning is a socio-emotional as well as cognitive process. The launch event is the online equivalent of a campus visit or a reception welcoming students to their new school, department, or major. For learning purposes, an introduction to a gamified online platform can send a clear message about how students are expected to engage with the environment and other participants in it: which approaches and practices from their current repertoire to keep, which ones to adjust and how, and which ones to discard. Are students expected to sit and be quiet, or are they supposed to be active and speak up? Listen and accept, or question? Repeat as told and follow step-by-step directions, or engage in trial-and-error iterative practices? And whether to engage in a practice typical of gamified learning environments that is rarely encouraged elsewhere: *fun failure*, the ability to make errors and failed attempts with joy rather than worry due to the low stakes of the attempt and the ability to redo and improve—the phenomenon that manifested itself during the launch event as the glitch that occurred half-way through the event (Cain and Piascik, 2015).

The introduction to the platform is also the first stage of the course's scaffolding. Scaffolding typically comprises two elements: stoking interest in a subject or a task, and providing structural support for tackling the task that the learner might not be able to solve on their own (Wood et al., 1976). Scaffolding is shown to effectively improve learning, especially for university students and including online environments (Doo et al., 2020; Cai et al., 2021). In our application of scaffolding, tasks that students need help with are expanded to include the logistics of navigating the platform. For many university-level students, even if a gaming/gamified platform is not new to them, using it as a learning environment often is. The rationale for giving students the opportunity to learn about and engage with the platform's various elements first, so that later they can focus principally on the learning tasks, thus follows the principles of effective scaffolding by building a learning path toward more complex tasks. By communicating and demonstrating by examples the potential of the platform to both make the learning process more engaging and more effective, it also addresses both aspects of the scaffolding process: stoking the interest and providing structural support.

The effects of inviting students to take the time to first familiarize themselves with the platform can be examined through the lens of working memory. During a learning task, the capacity of the working memory is occupied by processing the new information—intrinsic cognitive load, determined by the complexity of the information being processed—and by dealing with the logistics required for information processing—extraneous cognitive load, determined by the form and mechanics of the instructional procedure. When extraneous load is reduced by simplifying learning procedures, working memory can redirect its capacity to processing the information intrinsic to the learning task (Sweller, 2010; Sweller et al., 2019). Cognitive load theory's implications have received a relatively limited attention in educational development (Sweller et al., 2019). Also, its claim that attenuating extraneous load in favor of intrinsic promotes learning has recently begun to be challenged in the fields of digital and online learning by exploring learning strategies that differ from those promoted by the cognitive load theory (Paas and van Merriënboer, 2020; Skulmowski and Xu, 2021). The two-part onboarding structure we propose is supported by the theory's practical implications while addressing the criticism by shifting the extraneous cognitive load up front rather than utilizing it as a disfluency element throughout the learning process. The time and effort students need to put into familiarizing themselves with the technical aspects of learning on that particular platform (reduced extrinsic load) is placed up front, so that students' learning during the remainder of the course (increased intrinsic load) is not hindered by high cognitive load due to unfamiliarity with the gamified online learning environment.

Two-part onboarding thus asks students to both learn about a new learning environment and to engage with it. It asks students to be not only users but active participants. It is not only learning the course content by using the tools presented, but learning about the tools and

how they contribute to the learning process first. By tapping into student agency through scaffolding, engagements, and social interaction, the guided introduction aims to prompt students to engage with gamified learning platforms as places where professional expertise is shaped (Stenalt and Lassesen, 2021).

4. Discussion

When gamifying a learning process—whether it leads to GBL or gamification—it is important to recognize that the resulting learning environment will likely include rules of engagement that may be different from what students expect or what they are familiar with. Thus, to facilitate the learning process, it may be helpful to onboard students to the new learning environment via an onboarding process to the platform, which provides them with opportunities to engage with different elements of the new learning environment, including logistical and social aspects. In higher education, while gamified platforms are reported to have positive effects on student learning, implementing gamification still retains challenges and barriers regarding students' engagement, performance, and attitudes (Dicheva et al., 2015; Sabornido et al., 2022). We therefore examine the two-part onboarding—an opportunity to learn and practice both logistical and social rules in a new learning environment—as a game-design element that, based on the theories we analyzed and applied to it, can address some of those challenges and barriers and ultimately facilitate student learning.

The onboarding we present and examine combines two elements. One element is the tutorial, which typically includes procedural, set rules and learning how to go through predetermined steps and to navigate the space and its affordances. The second element is a launch event, during which students establish communication, engagement, and interaction rules. It recognizes that students come to the module with different backgrounds and experiences, and with few or no experienced users in a new environment from whom to learn rules of engagement and whose behaviors to emulate, students can use the launch event to establish and test out their own rules. Thus, students are given the opportunity internalize both the pre-set, structured rules (through the tutorial), and establish their own, open-ended ones (during the launch event). In other words, students are able to learn the design grammar of the new learning environment and to engage the extraneous cognitive load before they commence the learning module. By tackling both logistical and social aspects of the online GBL environment, students are given the opportunity to (re)shape and/or adjust their learning behaviors prior to starting the learning module. By frontloading the extraneous cognitive load of acquiring logistical and social skills to navigate the platform they free up the intrinsic cognitive load for fulfilling the learning goals of the module.

The two projects by ErasmusX have shaped online GBL environments that are both structured and open-ended: environments called *designed experience,* in which participants learn through a grammar of doing and being (Squire, 2006). While the Minecraft Virtual Campus project places more emphasis on the social experience, the Gather Escape Rooms project has a distinctly academic purpose that is driven by a GBL experience by the end of which students are expected to demonstrate expertise. Recognizing that learning is not merely a cognitive but also a socio-emotional process, both projects create learning environments with a positive course climate as a contributor to learning (Ambrose et al., 2010). By ushering students into spaces in which they are invited to combine their prior knowledge and skills with new modalities of engagement and interaction, students are both given permission and prompted to adjust and reshape their prior learning behaviors to maximize on the potential of gamified learning environments.

The two-part onboarding model is not a panacea nor is it to be used in isolation. It can be used in combination with other strategies that have shown positive effect on student learning in online learning environments. That includes active learning strategies, which have been argued for as effective as early as the term "virtual classroom" came into use (Hiltz, 1994), as well as intentional and structured course design, interactive content, continuous teacher engagement, and substantive feedback (Castro and Tumibay, 2021). The two-part onboarding can thus complement and work in synergy with other teaching and learning approaches to support online learning in GBL environments and potentially beyond.

The COVID-19 pandemic has not only expedited the shift from in-person instruction to online learning. It has also accelerated the inclusion of technology into educational practice and learning environments. While this transition can pose challenges and become overwhelming for both students and instructors, research in attribution theory shows that even small-scale interventions in framing student learning experience—such as a simple intervention preceding a university course—can measurably affect the learning trajectory and outcomes for students (Wilson and Linville, 1982; Wilson, 2011). The theoretical analysis we conducted shows that a two-part onboarding may be one such intervention for GBL environments.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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